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ABSTRACT

Students (n=45) in an introductory course in hydrology used a Vee map to guide their laboratory investigation. The Vee mapping technique was utilized by groups of students working together during the investigation and was graded with a scoring rubric developed by the instructor. At the end of the investigation, students completed a survey evaluating their perceptions of using the Vee map approach over the traditional, direct laboratory approach. The results of this study suggest that Vee maps have the potential to stimulate more thinking and learning than is commonly experienced in the traditional laboratory format. (DDR)

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Use of Vee Maps in a College Science Laboratory

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Use of Vee Maps in a College Science Laboratory

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Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), San Diego, CA
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ABSTRACT

Students in an introductory course in hydrology used a Vee-map to guide their laboratory investigation. Gowin's Vee-mapping technique was utilized by 2-3 students working together during the investigation and was graded with a scoring rubric developed by the instructor. At the end of the investigation, students completed a survey evaluating their perceptions about using the Vee-map approach of the traditional, direct laboratory approach. The results of this study suggest that Vee-maps have the potential to stimulate more thinking and learning than is commonly experienced in the traditional laboratory format.

Objective

The purpose of this study is to evaluate students' perceptions of a laboratory guided by Gowin's Vee mapping technique compared to the typical laboratories guided by the traditional format. The investigation seeks to uncover students' opinions on the inquiry aspects of the Vee mapping technique, such as designing their own experiments, generating and analyzing their data, and coming up with their own conclusions. The study also seeks to uncover students' opinions of their thinking and learning when they are guided by a Vee map compared to when they are guided by the traditional laboratory format. Finally, the study will uncover students' laboratory approach preferences and whether or not they would like to try the Vee map approach again in the future. Student perceptions of the Vee map tool will be helpful in evaluating whether this approach is worth employing routinely in college science laboratories.

Significance

Typical college science laboratories involve giving the students access to some lab equipment and handing them a detailed list of step-by-step instructions that are to be carried out in order to verify a principle that has

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already been established (Pickering, 1985; Schamel et al, 1992; Sundberg et al, 1994). Following the "recipe" does not require much thinking on the part of the students, except that they often think that they had better end up with the "correct" result (Leonard et al, 1988; Schamel, 1992). These traditional laboratories are often criticized for failing to emphasize the inquiry and process aspects of science (Journet, 1985; Medve et al, 1987; Nagalski, 1980; Pickering, 1985; Sundberg et al, 1994). Novak (1979) claims that students often do not understand why they are doing laboratory work, especially since the traditional approach does little to help students see connections between what they are doing and how it relates to scientific concepts.

A Vee map is a tool, developed by Gowin, that has been used to guide students in their laboratory experience, to facilitate reflective thinking and learning, as they plan and conduct their own investigations (Novak and Gowin, 1984). Although some studies of the usefulness of Vee maps have been done at the K-12 level, relatively few studies have been conducted at the college level. Therefore, this study of students perceptions of using Vee maps in place of the typical laboratory format is needed to help determine students' receptivity as well as the potential for this new approach to enhance the thinking and learning of students in the college laboratory.

Theoretical Base

A Vee map is a tool that enhances thinking and learning in addition to providing a better way of assessing students in the laboratory. This tool capitalizes on students' prior knowledge, which is thought by some to be a major influence in creating meaningful learning (Ausubel, 1963; Hewson and Hewson, 1983). Vee maps facilitate the process where students unify what they know with how they know it (Novak and Gowin, 1984), thus enabling them to better see the relevancy of laboratory work in the construction of their knowledge. Vee maps may also be considered a good assessment tool for practical (laboratory) work as they fulfill all four functions of assessment proposed by Hodson (1992): summative, formative, evaluative, and educative.

Methodology

Forty five University of Arizona students from a variety of grade levels (freshmen, sophomores, etc.) enrolled in a laboratory science course for non-science majors participated in the study. The course entitled *Water and the Environment* was comprised of a three hour per week lecture and a separate

three hour laboratory section. The study was conducted during one of the lab sessions, for each of three laboratory sections.

Gowin's Vee heuristic was utilized by groups of 2-3 students working together during the investigation on water hardness and conductivity. Students designed and implemented their own investigation based on a focus question posed by the instructor. The laboratory write-up consisted of a poster of the "V" in which the students presented their study. The Vee was graded using a rubric designed by the instructor.

A survey was administered to the students following the Vee laboratory. The survey was developed by instructors in the Department of Hydrology and Water Resources. After multiple revisions, a set of 17questions on a Likert scale along with an open-ended comment section was adopted for the student survey.

One-sample t tests at an alpha level = 0.05, were performed for each Likert scale question. The analysis was performed using a population mean of 3.0 (neutral).

Results

The results of this study are shown in **Table 1**. The null hypothesis was rejected for questions 1,3,4,5,6,7,9,10,11,13,16, and 17. Furthermore, the t test analyses resulted in failure to reject the null for questions 2,8,12,14, and 15.

Findings

Students who participated in the Vee map study reported the following perceptions of the new approach compared to the traditional laboratory approach:

1) Inquiry aspects of Vee map: Students disliked designing their own experiments, but liked figuring out for themselves how to present their data and come to their own conclusions.

2) Thinking and learning: The majority of the students (about 75%) believed they did more thinking and learning with the Vee map approach but the majority did not actually prefer the use of that approach.

3) Vee (in general): The majority of students would like to try the Vee map approach again and thought that it would become easier for them as they gained more experience in the new approach.

These results were supported by comments from the open-ended section of the survey.

> "I didn't understand what we were supposed to do at first, but in the end I liked it better [Vee map approach]."

> "I liked the Vee map approach. The traditional labs are more like baking a cake than science. I would encourage more use of Vee maps. It's more creative."

> " The Vee map approach is better because when the student is allowed to organize his/her own experiment, it makes more sense to them [sic]."

> "You can understand... [the vee map approach]... better."

> "I can see science coming together."

> "I got to do and set up the experiment which was very interesting...instead of only answering... [questions]."

> "It was more hands on and all what you and your group thought, not format (sic)."

> "It just took more time to understand the idea of what we were doing that's all, but the idea of doing a lab this way is kind of neat!"

> "...it was a good challenge. I think a mix of Vee map labs and traditional labs would be good."

Conclusions and Implications

For many students, this is the first time they have experienced taking responsibility for their own learning. Since students are typically not used to designing and conducting their own experiments or "thinking" in the science laboratory, it may take some time for them to get comfortable with this "minds-

on" approach. Therefore, although a little more than half the students indicated that they preferred the traditional laboratory format, this may be due to the high comfort level they have with that approach, especially considering that over 60% of the students indicated that they would like to try the Vee map approach again. The difficulty in trying a new method was also evident in that over 70% of the students believed the approach would get easier as they gained more experience with the new approach. This generally positive attitude toward coupled with the overwhelming consensus that they did more thinking and learning when they used the new approach implies that, with routine use, Vee maps may be a useful tool in the college laboratory.

The greatest difficulty in the implementation of this new technique in the classroom lies not in the students' use of the technique, but lies more in the instructors' ability to redesign the traditional labs and teach the new technique effectively. Most instructors do not have the time or experience necessary to redesign traditional labs and teach them so that they are more "mind-on", since they, themselves, have such little experience with this type of approach in the laboratory.

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TABLE 1. Results Of Likert Scale Questions. Average responses to questions about student opinions on Vee mapping vs. traditional laboratory approach. The scale ranged from "Strongly Disagree" (Value=1) to "Strongly Agree" (Value=5). The percentages provided here are the totals of those selecting either of the top two categories.

	Percent Agreement	Sig. at alpha=0.05
1. I liked being able to design my own experiment instead of being given step-by-step instructions.	42.2%	Y
2. I liked figuring out for myself what data I should collect.	37.8%	nsd
3. I liked making my own data table and graphs to represent my data instead of filling out pre-made tables and making graphs the lab book tells me to make.	57.8%	Y
4. I liked coming up with my own conclusions rather than answering questions out of the lab manual.	64.4%	Y
5. I usually have a clear idea of why we are doing the lab when we have traditional labs.	60.0%	Y
6. I was able to make more sense of the lab when we used the Vee map approach than I usually can when we do most other labs.	44.4%	Y
7. I was able to make more connections of science concepts when we did the Vee map lab than when we do most other labs.	46.7%	Y
8. I feel like I am doing science when I do most traditional labs.	42.2%	nsd
9. I felt like I was doing science when I did the Vee map lab.	46.7%	Y
10. In general, I believe I did more thinking when I did the Vee map lab than during most traditional labs.	77.8%	Y
11. I think I learned more during the Vee map lab than I do normally in the traditional labs.	73.33%	Y

12	I do not have to think as much when I do traditional labs.	28.9%	nsd
13	In general, I liked using the Vee map format in lab better than I like the traditional laboratory format.	46.7%	Y
14	I would like lab better if we always used the Vee map approach instead of always using the traditional lab format.	33.3%	nsd
15	I was initially uncomfortable with the Vee map approach.	28.9%	nsd
16	I think the more labs I do that use the Vee map approach, the easier it will get for me to use them.	71.1%	Y
17	I would like to try using the Vee map format again sometime in lab.	60.0%	Y